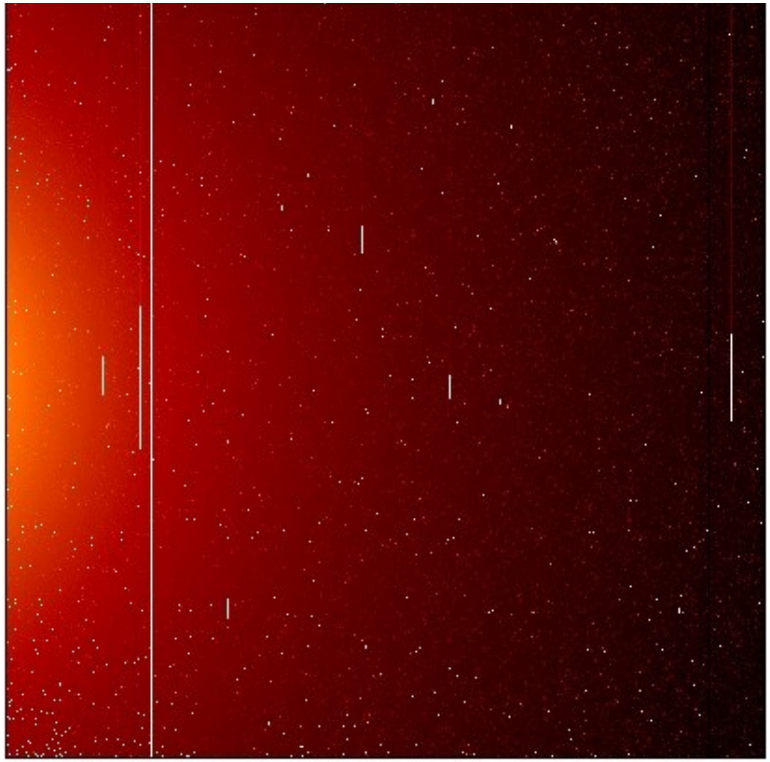
Space Weather and HI

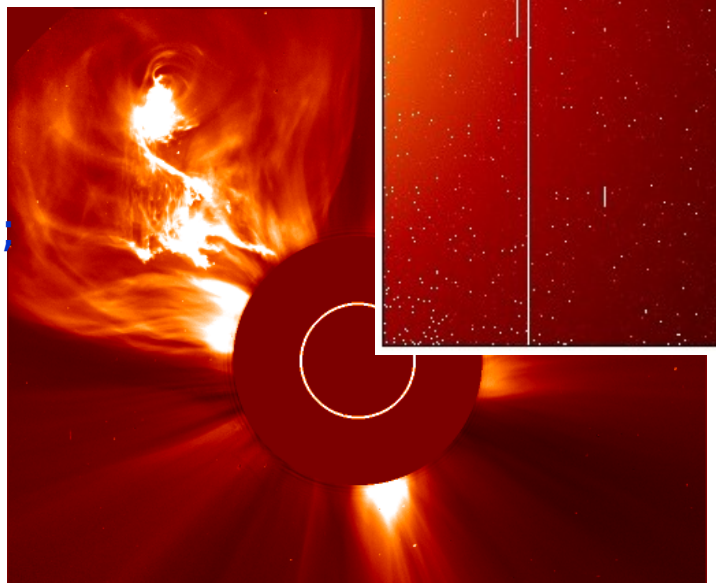
Chris Davis & Richard A. Harrison, RAL

STEREO is a major mission for Space Weather, both for ‘enabling science’ and for monitoring.

HI is a key part of this because it is -

- the first instrument to view Earth directed CMEs in interplanetary space along the Sun-Earth line;
- the first instrument to detect CMEs in the same field of view as the Earth;
- the first instrument to make stereographic observations of CMEs in the heliosphere.





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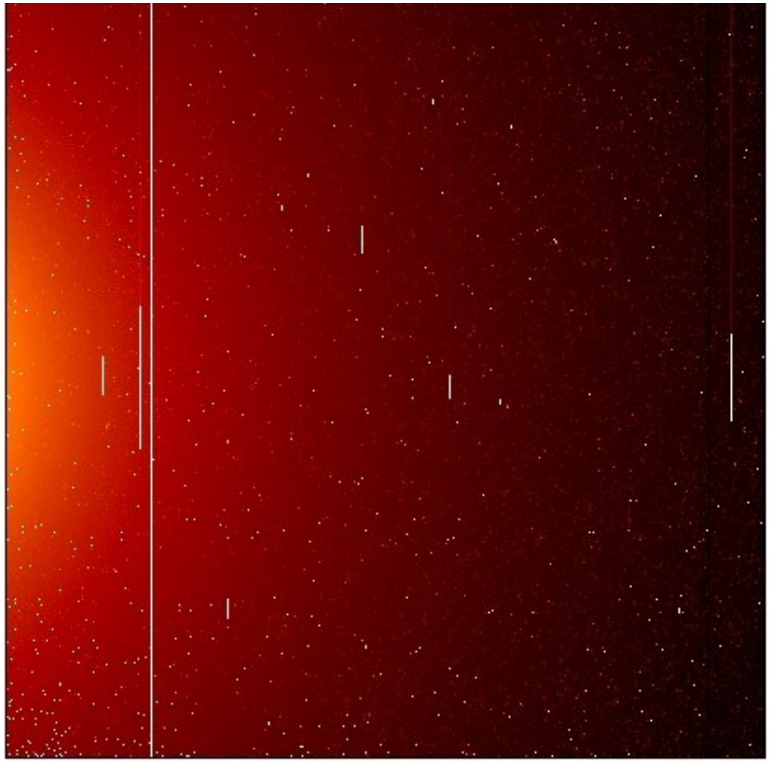
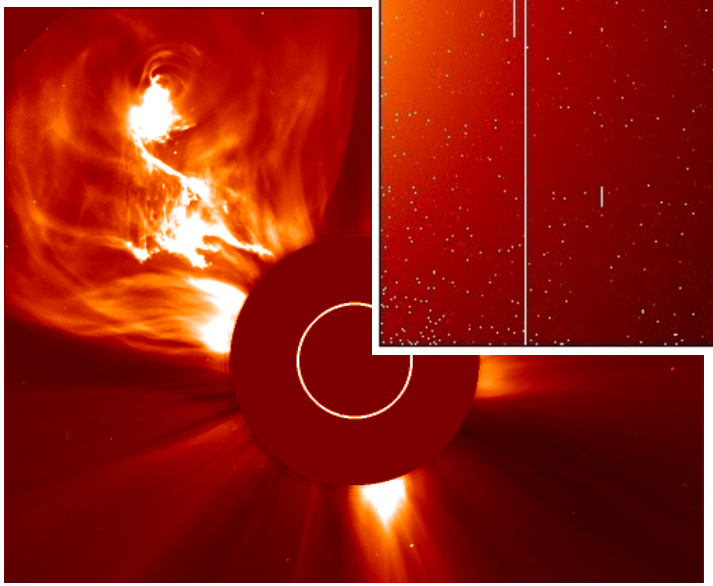
Questions:

- What ‘tools’ and ‘products’ can HI provide for space weather studies and monitoring?

- What options are there for the synoptic operation and for the broadcast/beacon data?





HI Space Weather ‘Tools’

Research ‘products’ & event prediction

- Direct observations of interplanetary CMEs from two sites, allowing identification of Earth-directed CMEs, and projections in time and space for arrival at Earth.
- Direct observations of arrival of CMEs at Earth, enabling short-term prediction and analyses of impact-associated activity with Earth-based or Earth-orbit measurements.
- Determination of the structure and evolution of CMEs in 3D in the heliosphere, enabling a better understanding of CME evolution and propagation.
- Analysis of CME events detected by remote sensing from one STEREO spacecraft and in-situ at the other, to better understand CME structure.

HI Space Weather ‘Tools’

Research ‘products’ & event prediction

The last slide detailed specific approaches & tools using the synoptic or standard operation of HI, i.e. using normal operations & analysis on the ground – with, perhaps, prediction capabilities of order a few hours at best – but with human involvement.

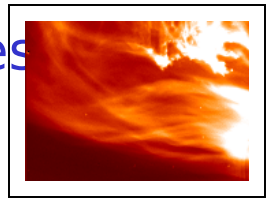
The other approach is the use of HI ‘tools’ provided through the STEREO broadcast/beacon data-stream.

HI Space Weather ‘Tools’

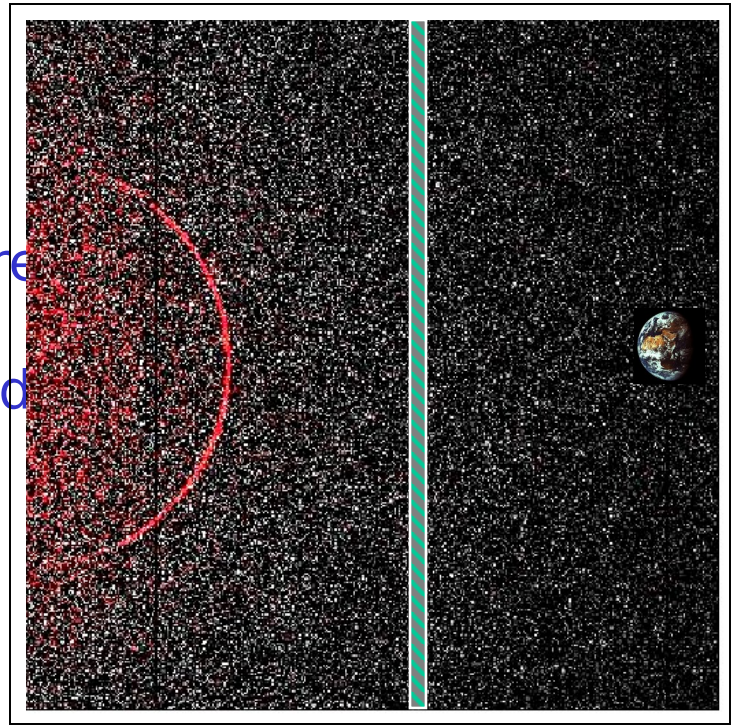
Research ‘products’ & event prediction

Suggested HI ‘tools’ provided through the STEREO broadcast/beacon data-stream:

- Thumbnail images



- A simple CME index – e.g. monitored intensity of a N-S strip of pixels between the Sun and Earth, returned as a single index



- On-board event recognition

HI Space Weather ‘Tools’

Questions

The basic aim is to develop a practical tool for event prediction and monitoring. To assess the requirements, we must ask a number of questions at this time - to ensure that the software and operations scenarios support what we need:

Question 1: What sort of ‘warning times’ and accuracy could we expect? Is synoptic operation and ground analysis enough? This might give a few hours warning. Do we need to do better than that? Why?

HI Space Weather ‘Tools’

Questions

Question 2: Can we expect to develop tools prior to launch or do we need to learn to use HI first? We ought to have some basic tools in place, but expect some in-flight development as we get to know the HI data.

However, the on-board software requirements must ensure enough flexibility to cater for this.

HI Space Weather ‘Tools’

Questions

Question 3: Can we develop a method for obtaining information at better than the standard synoptic cadence for the beacon? What are the telemetry limitations for the beacon with respect to HI? Is this compatible with our plans?

Question 4: How can we best take advantage of the twin spacecraft view? Is the STEREO view a scientific research ‘ttol’ rather than a Space Weather ‘tool’? Can we use 3D interpretations to make better predictions?

HI Space Weather 'Tools'

Questions

Question 5: With regard to space weather issues, how can we make the best use of combining STEREO data with data from SOHO, Solar-B, ACE, SMEI, SDO, some of which will be operational during the STEREO period? The STEREO Space Weather group must study this aspect of the mission.

HI Space Weather ‘Tools’

UK Involvement

- We anticipate the use of the UK RAL ground station for broadcast data, much as we now do for ACE. Initial discussions have taken place.
- We plan a UK STEREO/HI archive.
- The UK has involvement in Solar-B, SOHO, ACE, SMEI, etc… as well as STEREO which might be useful for inter-spacecraft space weather observation/interpretation.